3.9 LOS ALAMOS NATIONAL LABORATORY

Los Alamos National Laboratory was established in 1943 as a nuclear weapons design laboratory and was formerly known as the Los Alamos Scientific Laboratory. Its facilities are located in north central New Mexico about 40 km (25 mi) northwest of Santa Fe. Figure 2.2.8–1 indicates the regional location of LANL and Figure 2.2.8–2 shows the locations of the technical areas which contain the major facilities within the site boundaries. LANL is owned by DOE and operated by the University of California under contract to DOE.

The central mission of LANL has evolved from developing the first atomic bomb during World War II to developing nuclear weapons for deterrence during the Cold War. With the recent easing of international tensions, the central mission of LANL has been redefined to one of developing a multidisciplinary science and technology research facility that is engaged in a variety of programs for DOE and other Government agencies and applying this expertise to the Nation's security and well being. Current missions at LANL are listed in Table 3.9–1.

Table 3.9–1. Current Missions at Los Alamos National Laboratory

Mission	Description	Sponsor
Nuclear weapons	Stockpile stewardship and management, materials support, fissile materials disposition	Assistant Secretary for Defense Programs
Environmental management	Environmental restoration, waste management, pollution prevention, technology development	Assistant Secretary for Environmental Management
Nonproliferation and international security	Nonproliferation and verification R&D, nuclear safeguards and security, arms control and nonproliferation, intelligence	Office of Intelligence and National Security
Energy research	Nuclear physics, biological and environmental research, basic energy sciences, magnetic fusion, high energy physics	Office of Energy Research
Energy technology	Enhanced energy production, improved energy efficiency, environmental consequences, medical radioisotope production	Assistant Secretary for Energy Efficiency and Renewable Energy; Assistant Secretary for Fossil Energy; Offices of Nuclear Energy and Civilian Radioactive Waste Management
Work for others	Conventional weapons technology, modeling and simulation, beams and sensors, high performance computing	DoD, NRC, other Federal and non-Federal entities.

Source: LANL 1995b:1.

Department of Energy Activities. The major DOE program activities at LANL include defense, environmental management, nonproliferation and international security, and energy research and technology. These programs, as well as others at LANL, are interdependent and have considerable overlap. Defense programs address nuclear weapons technology, nuclear materials and reconfiguration technology, and programs conducted by the Los Alamos Neutron Scattering Center (LANSCE) and Energy Research Program Office. Environmental management programs are primarily focused on restoration activities and attaining and maintaining compliance with all Federal and State regulations and permits for waste management. The nonproliferation and international security programs respond to the scientific and technological needs to assure the effective reduction in the proliferation of nuclear weapons, the means to deliver them, and to ensure U.S. and international security.

Energy research and technology programs principally address basic science and technology issues that contribute significantly to defense, national security, industrial competitiveness, and energy resources.

The Nuclear Weapons Technology Program is the principal defense program at LANL and is devoted to providing technology stewardship for the nuclear stockpile. Important aspects of stockpile stewardship at LANL include stockpile surveillance, surety, and aboveground experiments, all of which help in the absence of underground nuclear testing. The Nuclear Materials and Stockpile Management (NMSM) Program addresses a wide spectrum of activities in nuclear materials handling, processing, and fabrication in support of the DOE objectives of reducing the nuclear danger and addressing cleanup issues across the DOE complex. Two major interfaces for NMSM are the stockpile support and reconfiguration/nuclear materials management programs. LANL continues to support DOE's stockpile evaluation and pit rebuild efforts. Stockpile evaluation is currently focused on surveillance of milliwatt radioisotopic thermoelectric generators, surveillance of selected gas systems, and the pit surveillance effort, which was formerly conducted at RFETS.

The LANSCE and L/ER conduct several programs in the areas of science and technology that contribute to a wide spectrum of fundamental and strategic research. In addition to research activities, L/ER programs operate a major user facility for neutron research and applications supporting research by DP users, among others.

Environmental Management Program activities at LANL consist of environmental restoration, waste management, pollution prevention, independent technical assessments and environmental technology development. The major environmental management effort at LANL is assessing and remediating over 2,000 sites that may have been contaminated over the past 50 years and have been designated for corrective action investigations. One component of the environmental restoration program is the D&D of sites and facilities such as nuclear reactors and surplus contaminated facilities. Waste management activities are directed at attaining and maintaining compliance with all regulations and permits.

The Nonproliferation and International Security Program was created at LANL to develop and apply the science and technology capabilities needed to deter, detect, and respond to proliferation of weapons of mass destruction and thereby to help ensure U.S. and international security. Those LANL programs to control and prevent the proliferation of nuclear weapons throughout the world that are funded within the nuclear weapons research, development, and technology program are focused primarily on nuclear counterproliferation and emergency response issues.

In addition to the neutron research and applications at LANSCE, other related energy research includes nuclear and high energy physics, basic energy sciences, biological and environmental research, and fusion energy. Energy technology programs at LANL include energy production, energy utilization, and the environmental consequences of energy production and utilization. Energy production programs are funded by the Assistant Secretary for Defense Programs as well as the other DOE energy-source-specific program offices. The type of effort performed for the Assistant Secretary for Defense Programs is in the area of nuclear safety review work for both reactor and nonreactor facilities.

Non-Department of Energy Activities. Non-DOE activities at LANL include support to DoD, NRC, other Federal agencies (National Aeronautics and Space Administration, National Institutes of Health, NOAA, National Science Foundation, and others), and various other institutions and industries. For DoD and branches of the military, LANL provides support in the areas of conventional weapons technology; modeling and simulation; beams and sensors; high performance computing; and advanced concepts in structures and materials, nonlethal technologies, unmanned aerial vehicles, missiles, micromachines, and other state-of-the-art technological applications.

3.9.1 LAND RESOURCES

Land Use. The LANL is located in north-central New Mexico, 97 km (60 mi) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Española in Los Alamos and Santa Fe Counties. The associated communities of Los Alamos and White Rock are in Los Alamos County. The 11,300-ha (28,000-acre) LANL site and adjacent communities are situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons that run from the Jemez Mountains on the west toward the Rio Grande Valley on the east. Mesa tops range in elevation from approximately 2,400 m (7,800 ft) on the west to about 1,900 m (6,200 ft) on the east (LANL 1994a:II-1,II-2).

Existing Land Use. The developed acreage of LANL consists of 30 active TAs. These TAs consist of laboratory facilities and support infrastructure. They account for only a small portion of the total land area at LANL. Most of LANL is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at LANL, nor are there any prime farmlands. In 1977, DOE designated LANL as a NERP, which is used by the national scientific community as an outdoor laboratory to study the impacts of human activities on the pinyon-juniper woodland ecosystems (DOE 1985a:3,21).

Most developments within Los Alamos County are confined to mesa tops. Generalized land uses are shown in Figure 3.9.1–1. The surrounding land is largely undeveloped with large tracts north, west, and south of the LANL site administered by the U.S. Forest Service (Santa Fe National Forest), the National Park Service (Bandelier National Monument), and Los Alamos County. The San Ildefonso Pueblo borders the LANL site to the east (LANL 1994a:II-1,II-2). The closest offsite residences to LANL are approximately 3 m (10 ft) from the northern boundary.

Land-Use Planning. The *Site Development Plan Annual Update 1993* Master Plan designates TA-55 as Special Nuclear Material Research and Development. The *Site-Wide Environmental Impact Statement for Los Alamos National Laboratory* (LANL Site-Wide EIS) is currently being prepared and analyzes four future alternatives for LANL's operation over the next 5 to 10 years. An analysis of future operation, facilities, and buffer zones would be anticipated to be included (LANL 1996e:4).

Land-use planning occurs at the local level in New Mexico, with counties and cities preparing future land-use plans called comprehensive plans or general plans. Los Alamos County has a comprehensive plan and a development code that contains zoning. However, LANL is autonomous from a planning perspective and therefore, is not addressed in the county plan and code (NM County 1996a:1). The *Santa Fe County General Plan* land-use designations are based on groundwater protection goals. Therefore, the Plan designates LANL as "Agricultural and Residential" (NM County 1996a:2).

Visual Resources. Development and operation of DOE facilities has disturbed the character of the landscape in their respective areas. The DOE facilities are generally brightly lit at night and highly visible from nearby viewpoints, and are visible from as far away as southeast Santa Fe (approximately 48 km [30 mi]). The developed areas of LANL are consistent with a VRM Class 5 designation. The remainder of LANL ranges from VRM Class 3 to Class 4 designation.

Offsite viewpoints affected by DOE facilities are primarily associated with the Los Alamos townsite and New Mexico State Highways 4, 501, and 502. On a clear day, views can exceed 80 km (50 mi). Topographic relief and heavy vegetation provide significant visual screening of LANL facilities, especially from mid- and long-distance viewpoints.

3.9.2 SITE INFRASTRUCTURE

Baseline Characteristics. Section 3.9 describes the current LANL missions. Baseline characteristics are shown in Table 3.9.2–1.

Table 3.9.2–1. Los Alamos National Laboratory Baseline Characteristics

Characteristics	Current Usage	Site Availability
Transportation		
Roads (km)	137	137
Railroads (km)	0	0
Electrical		
Energy consumption (MWh/yr)	381,425	500,000
Peak load (MWe)	87	100
Fuel		
Natural gas (m^3/yr)	43,414,560	103,368,000
Oil (l/yr)	0[a]	0[a]
Coal (t/yr)	0	0
Steam (kg/hr)	33,554	234,000

[a] Oil is stored as a backup fuel source for natural gas.
Source: LANL 1990b; LANL 1995b:1.

The major existing highways that serve LANL are depicted on Figure 2.2.8–1. LANL is served by an extensive system of roads and parking facilities. Roadways are aligned with the predominant topography of east/west canyons and mesas. Cross-canyon travel is limited to the Los Alamos Canyon Bridge, West Road, and State Route 4 to the southeast. There are approximately 137 km (85 mi) of paved roads and 113 km (70 mi) of dirt or gravel roads and fire lanes. All materials shipped from locations outside LANL are first received or shuttled through TA-3. The nearest rail service is in Santa Fe, approximately 40 km (25 mi), southeast of LANL.

Locally, LANL is supplied with electricity by a Los Alamos County/DOE power pool. It also has a 20 MWe gas-fired generating plant in TA-3. Electricity is transmitted to the site and the County over two 115 kV lines, one from Santa Fe (Norton Generating Station) and one from Albuquerque (Reeves Generating Station). These lines enter LANL near TA-5 (Eastern Technical Area substation). Electricity is distributed throughout the site via 13.2 kV lines. The 115 kV system includes a loop that ties substations at TAs -3, -5, and -53 together. This looping ensures a power supply throughout LANL should outages occur in any major line. The total annual power consumption is considerably below the transmission capacity of the system. The sub-regional electric power pool from which LANL draws its power is the Arizona-New Mexico Power Area. Capabilities of this power pool are summarized in Table 3.9.2–2.

Table 3.9.2–2. Arizona-New Mexico Sub-Regional Power Pool Electrical Summary

Characteristics	Energy Production
Type Fuel[a]	
Coal	57%
Nuclear	24%
Hydro/geothermal	4%
Oil/gas	15%
Other[b]	0.3%
Total Annual Production	79,491,000 MWh
Total Annual Load	83,794,000 MWh
Energy Imported Annually[c]	4,325,000 MWh
Generating Capacity	17,023 MWe
Peak Demand	15,679 MWe
Capacity Margin[d]	3,081 MWe

[a] Percentages do not total 100 percent due to rounding.

[b] Includes power from both utility and nonutility sources.

[c] Energy imported is not the difference of production and load due to negative net pumped storage.

[d] Capacity margin is the amount of generating capacity available to provide for scheduled maintenance, emergency outages, system operating requirements, and unforeseen electrical demand.

Source: NERC 1993a.

Natural gas is supplied to LANL from the San Juan Basin in northwest New Mexico. The lines are owned by DOE but operated and maintained by the Gas Company of New Mexico under contract to DOE. LANL depends on natural gas for most space heating requirements. Gas-fired forced air furnaces, hot water boilers, and steam boilers are some of the equipment used. Natural gas is distributed to buildings directly, or to three central steam plants (TAs -3, -16, and -21), and a standby plant for fueling the heating system. All plants also maintain reserves of fuel oil.

Water for LANL and adjacent areas (including Los Alamos townsite, White Rock, and Bandelier National Monument) primarily comes from three DOE-owned well fields and surface water from the Jemez Mountains. The system depends on gravity flow for distribution from high elevation terminal storage facilities.

Plutonium is stored in approximately 9,400 packages at 24 facilities within LANL. More than 90 percent of LANL's Pu inventory is located in 7,700 packages stored at the TA-55 facility. Research at the TA-55 facility includes Pu recovery processes, Pu metal fabrication, Pu-238 general purpose heat source and radioisotope thermoelectric generator production, and advanced fuel fabrication. Renovation of the Nuclear Materials and Storage Facility at TA-55 has been proposed to correct design and construction deficiencies that have prevented the use of this facility and to ensure that the facility can be operated safely and effectively. Operation of this facility would provide a centralized capability for consolidation and intermediate and long-term storage for LANL nuclear material inventories.

Plutonium analytical operations are conducted in the TA-3 CMR Building (SM-29), which has laboratories, hot cells, a waste assay facility and a vault. The Los Alamos Critical Experiments Facility, remotely located in TA-18, uses Pu in nuclear criticality experiments. These experiments generate insignificant quantities of fission and activitation products. The critical assemblies are in buildings called kivas. Pu in metal and oxide forms is stored in vaults in each kiva and also in the Hillside Vault. There are also 21 other technical areas that store small quantities of Pu materials.

3.9.3 AIR QUALITY AND NOISE

Meteorology and Climatology. Los Alamos has a semiarid, temperate mountain climate. The climate averages for atmospheric variables such as temperature, pressure, moisture, and precipitation are based on observations made at the TA-59 LANL weather station from 1961 through 1993. The meteorological conditions described here are representative of conditions on the Pajarito Plateau at an elevation of approximately 2,250 m (7,400 ft) above sea level (LANL 1995s:II-8). In July, the average daily high temperature is 27.2 °C (81 °F), and the average nighttime low temperature is 12.8 °C (55 °F). The average January daily high is 4.4 °C (40 °F), and the average nighttime low is -8.3 °C (17 °F). The highest recorded temperature is 35 °C (95 °F), and the lowest recorded temperature is -27.8 °C (-18 °F). The large daily range in temperature of approximately 13 °C (23 °F) results from the site's relatively high elevation and dry, clear atmosphere, which allows high insolation during the day and rapid radiative losses at night (LANL 1995s:II-8). Additional information related to meteorology and climatology at LANL is presented in Appendix F.

The average annual precipitation is 47.6 cm (18.7 in) but is quite variable from year to year. The lowest recorded annual precipitation is 17.3 cm (6.8 in), and the highest is 77.1 cm (30.3 in). The maximum precipitation recorded for a 24-hour period is 8.8 cm (3.5 in) (LANL 1995s:II-11). Because of the eastward slope of the terrain, there is a large east-to-west gradient in precipitation across the plateau. White Rock often receives about 13 cm (5 in) less annual precipitation than the TA-59 weather station, and the eastern flanks of the Jemez Mountains often receive about 13 cm (5 in) more (LANL 1994a:II-11).

Los Alamos winds are generally light, averaging 2.8 m/s (6.3 mph). Strong winds are most frequent during the spring when peak gusts often exceed 22 m/s (50 mph). The highest recorded wind gust was 34.4 m/s (77 mph). The semiarid climate promotes strong surface heating by day and strong radiative cooling by night. Because the terrain is complex, heating and cooling rates are uneven over the LANL area, which results in local thermally generated winds (LANL 1995s:II-11).

Ambient Air Quality. The LANL is located within the New Mexico Intrastate AQCR 157. None of the areas within LANL and its surrounding counties are designated as nonattainment areas with respect to any of the NAAQS (40 CFR 81.332). A nonattainment area is an area that has air quality worse than designated by NAAQS for one or more criteria pollutants. Applicable NAAQS and New Mexico State ambient air quality standards are presented in Appendix F.

The criteria pollutants—NO_2, CO, hydrocarbons, PM_{10}, and SO_2—make up approximately 79 percent of the stationary source emissions at LANL. The source of these criteria pollutants is combustion in power plants, steam plants, asphalt plants, and local space heaters. Toxic and other hazardous pollutants represent the remaining 21 percent of emissions from stationary sources at LANL. These emissions are generated by equipment surface cleaning, coating processes, and acid baths, and include gases, vapors, metal dusts, and miscellaneous emissions, such as wood dust, hazardous gases, and plastics (LANL 1994a:VI-1,VI-3).

One PSD Class I Area, the Bandelier National Monument's Wilderness Study Area, borders LANL to the south. To date, LANL has not been subject to PSD requirements (LANL 1993b:III-20).

Ambient concentration limits for hazardous/toxic air pollutants (to be used by the State as one of the criteria in evaluating construction permit applications for a new emission source) have been approved by the New Mexico Environmental Improvement Board. The estimated 2005 No Action annual emission rates from LANL facilities are listed in Table F.1.2.9–1. Estimates of maximum ground-level concentrations at or beyond the LANL boundary are listed in Table 3.9.3–1. Concentrations of criteria and hazardous/toxic air pollutants are in compliance with applicable guidelines and regulations. The hazardous/toxic air pollutant limits are one-hundredth of the recognized occupational exposure levels (for example, 8-hour time-weighted threshold limit values).

Table 3.9.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Los Alamos National Laboratory, 1990 and 1992

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Criteria Pollutants			
Carbon monoxide	8-hour	7,689[a]	115
	1-hour	11,578[a]	630
Lead	Calendar quarter	1.5[b]	<0.01
Nitrogen dioxide	Annual	73[a]	3.8
	24-hour	145[a]	[c]
Ozone	1-hour	235[b]	[d]
Particulate matter less than or equal to 10 microns in diameter[e]	Annual	50[b]	8
	24-hour	150[b]	21
Sulfur dioxide	Annual	40[a]	1.3
	24-hour	202[a]	[c]
	3-hour	1,300[b]	[c]
Mandated by the State of New Mexico			
Hydrogen sulfide	1-hour	11[a]	[c]
Total reduced sulfur	30-minute	3[a]	[c]
Total suspended particulate[e]	Annual	60[a]	8
	30-day	90[a]	<21
	7-day	110[a]	<21
	24-hour	150[a]	21
Hazardous and Other Toxic Compounds[f]			
Acetic acid	8-hour	250[a]	2.87
Ammonia	8-hour	180[a]	4.27
2-Butoxyethanol	8-hour	1,200[a]	0.66
Chlorine	8-hour	[g]	0.07
Chloroform	8-hour	500[a]	2.92
Ethyl acetate	8-hour	14,000[a]	0.49
Ethylene glycol	8-hour	[g]	0.39
Formaldehyde	8-hour	15[a]	0.27
Heavy metals	8-hour	[g]	0.62
Heptane (n-heptane)	8-hour	[g]	10.12
Hexane (n-hexane)	8-hour	[g]	0.41
Hydrogen chloride	8-hour	[g]	3.41
Hydrogen fluoride	8-hour	[g]	1.29
Isopropyl alcohol	8-hour	9,800[a]	2.88
Kerosene	8-hour	[g]	1.42
Methyl alcohol	8-hour	[g]	3.14
Methyl ethyl ketone	8-hour	[g]	9.95
Methylene chloride	8-hour	[g]	5.90
Nickel	8-hour	10[a]	0.30
Nitric acid	8-hour	50[a]	3.53

Table 3.9.3–1. Comparison of Baseline Ambient Air Concentrations With Most Stringent Applicable Regulations or Guidelines at Los Alamos National Laboratory, 1990 and 1992—Continued

Pollutant	Averaging Time	Most Stringent Regulation or Guideline ($\mu g/m^3$)	Baseline Concentration ($\mu g/m^3$)
Hazardous and Other Toxic Compounds[f] (Continued)			
Nitrogen oxide	8-hour	[g]	2.29
Nonmethane hydrocarbons	8-hour	[g]	15.83
Propane sultone	8-hour	400[a]	1.12
Stoddard solvent	8-hour	5,250[a]	1.41
Toluene	8-hour	[g]	13.2
1,1,2-Trichloroethane	8-hour	[g]	4.95
Trichloroethylene	8-hour	[g]	1.12
Tungsten (as W)	8-hour	50[a]	0.60
VM&P Naphtha	8-hour	13,500[a]	3.27
Welding fumes	8-hour	[g]	2.8
Xylene	8-hour	[g]	9.41

[a] State standard. The conversion from ppm to $\mu g/m^3$ for the ambient air quality standard is calculated with the corrections for temperature (530 °Rankine) and pressure (elevation) 2,255 m mean sea level.

[b] Federal standard.

[c] No monitoring data available; baseline concentrations assumed less than applicable standard.

[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. See Section 4.1.3 for a discussion of ozone-related issues.

[e] It is assumed that all particulate matter concentrations are total suspended particulate concentrations.

[f] Compounds listed are the major pollutants (11.34 kg/yr or more) of concern.

[g] No standard.

Source: 40 CFR 50; DOE 1995hh; LANL 1993b; LANL 1994a; NM EIB 1995a; NM EIB 1996a.

Table 3.9.3–1 presents the baseline ambient air concentrations for criteria pollutants for 1992 and other pollutants of concern for 1990 at LANL. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Noise. The major noise sources at LANL include various facilities, equipment, and machines (for example, cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, vehicles, pistol and rifle firing range, and explosives detonation). No LANL environmental noise survey data are available. At the LANL boundary, away from most of the industrial facilities, noise from most of these sources is barely distinguishable from background noise levels.

Impulsive noise from explosive testing can be heard occasionally in Los Alamos Townsite, White Rock Communities, and Bandelier National Monument. The acoustic environment along the LANL boundary away from traffic noise, although not measured, is expected to be that of a rural location with typical DNL levels in the range of 35 to 50 dBA (EPA 1974a:B-4). Traffic is the primary source of noise at the site boundary and residences near roads. The acoustic environment in the town of Los Alamos is similarly expected to be that of a suburban location with typical DNL in the range of 53 to 62 dBA (EPA 1974a:B-5).

The State of New Mexico has not established specific numeric environmental noise standards applicable to LANL. Los Alamos County has adopted a noise ordinance that specifies maximum sound levels in residential areas. (This ordinance is discussed in Appendix F.) Although the maximum levels specified by the ordinance

and the EPA guideline may be exceeded occasionally at the LANL boundary, this is expected to be attributable to traffic noise and not to sources at LANL; the ordinance does not apply to traffic noise.

3.9.4 WATER RESOURCES

Surface Water. The Rio Grande is the major surface water feature in north-central New Mexico. All surface water drainage and groundwater discharge from the Pajarito Plateau ultimately arrives at the Rio Grande. The Rio Grande at Otowi, just east of Los Alamos, has a drainage area of 37,037 km^2 (14,300 mi^2) in southern Colorado and northern New Mexico.

The major canyons that contain reaches of ephemeral streams within LANL are Pajarito, Water, Ancho, and Chaquehui Canyons (Figure 3.9.4–1). Ephemeral streams in the lower portions of Ancho and Chaquehui Canyons extend to the Rio Grande without being depleted. In lower Water Canyon, the ephemeral stream is very short and does not extend to the Rio Grande. In Pajarito Canyon, Homestead Spring feeds an ephemeral stream 3.2- to 4.8-km (2- to 3-mi) long.

Springs between 2,408- and 2,713-m (7,900- and 8,900-ft) elevation on the eastern slope of the Jemez Mountains supply base flow throughout the year to the upper reaches of Cañon de Valle, Los Alamos, Pajarito, and Water Canyons. These springs discharge water perched in the Bandelier Tuff and Tschicoma Formation at rates from 0.0001 to 0.0085 m^3/s (0.0035 to 0.30 ft^3/s). The volume of flow from the springs is insufficient to maintain surface flow within more than the western third of the canyons before it is depleted by evaporation, transpiration, and infiltration (DOE 1995hh:4-26).

Eleven drainage areas, with a total area of 212 km^2 (82 mi^2) pass through the eastern boundary of LANL. Runoff from heavy thunderstorms and heavy snowmelt reaches the Rio Grande several times a year from some drainages. Los Alamos, Pajarito, and Water Canyons have drainage areas greater than 26 km^2 (10 mi^2). Pueblo Canyon has a drainage area of 21 km^2 (8 mi^2), while all others have less than 13 km^2 (5 mi^2). The overall flood risk to LANL is low because nearly all the structures are located on the mesa tops, from which runoff drains rapidly into the deep canyons (DOE 1995hh:4-76). No surface water is withdrawn at LANL for either drinking water or facility operations (DOE 1993j:4-76).

Los Alamos, Sandia, and Mortandad Canyons currently receive treated industrial or sanitary effluent. Pueblo Canyon does not receive LANL effluents. Surface waters in these canyons are not a source of municipal, industrial, or agricultural water supply. Several times during the year heavy precipitation or snowmelt would cause waters from several canyons to extend beyond LANL boundaries and reach the Rio Grande (LANL 1995s:II-7).

In Mortandad Canyon, no surface runoff to LANL's boundary has occurred since studies were initiated in 1960. Pueblo Canyon received both untreated and treated industrial effluents from 1944 to 1964. It currently receives treated sanitary effluents from Los Alamos County treatment plants in its upper and middle reaches (DOE 1993j:4-76).

Existing wastewater generation from LANL is approximately 693 million l/yr (183 million gal/yr) (DOE 1993j:4-76). Permitted effluent discharges at LANL emerge from 2 sanitary wastewater treatment facilities and 130 industrial outfalls. These outfalls include power plant discharges (1 outfall), boiler blowdown (2 outfalls), treated cooling water (38 outfalls), noncontact cooling wastewater (51 outfalls), radioactive waste treatment plant (1 outfall), HE wastewater (21 outfalls), photographic laboratory rinse wastewater (13 outfalls), printed circuit board process wastewater (1 outfall), and sanitary wastewater (2 outfalls) (LANL 1995s:D-3).

Surface Water Quality. The 1993 surface water quality monitoring results for the five onsite canyons are presented in Table 3.9.4–1. The overall compliance for sanitary and industrial discharges during 1993 was 100 percent and 99.1 percent, respectively.

Water Rights and Permits. Water rights in New Mexico fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriated water for a beneficial use has priority to use available water supply

Table 3.9.4–1. Summary of Surface Water Quality Monitoring at Los Alamos National Laboratory, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[a]	Pajarito Canyon[b]	Pueblo Canyon[c]	Los Alamos Canyon[d]	Sandia Canyon[e]	Mortandad Canyon[f]
Bicarbonate	mg/l	NA	68	141	138	146	138
Calcium	mg/l	NA	28	.15	36	22	38
Carbonate	mg/l	NA	<5	<5	<5	<5	<5
Cesium-137	pCi/l	120[g]	1.0±1.5	2.3±1.3	3.0±1.3	3.0±1.2	NA
Chloride	mg/l	250[h]	58	34	111	70	9
Fluoride	mg/l	4.0[i],2.0[h]	0.1	0.4	0.7	0.9	0.6
Magnesium	mg/l	NA	7.1	2.6	2.5	4.6	3.5
Nitrate	mg/l	10.0[i]	0.04	4.53	<0.04	2.8	18
pH	pH units	6.8-8.5[h]	7.9	7.3	7.8	8.6	8.2
Phosphate	mg/l	NA	0	5.3	0.1	2.5	0.6
Plutonium-238	pCi/l	1.6[g]	-0.005±0.042	- 0.019±0.030	-0.036±0.030	0.004±0.030	748±0.058
Plutonium-239/240	pCi/l	1.2[g]	0.006±0.028	0.006±0.020	0.118±0.024	0.012±0.020	493±0.046
Potassium	mg/l	NA	5	N/A	7	N/A	5
Sodium	mg/l	NA	28	40	87	110	60
Strontium-90	pCi/l	400[g]	0±0.7	2.2±0.7	0±0	1.0±0.9	33.7±2.2
Sulfate	mg/l	250[h]	13	23	12	100	9
Total dissolved solids	mg/l	500[h]	228	404	356	558	302
Total hardness as $CaCO_3$	mg/l	NA	106	55	104	72	110
Tritium	pCi/l	80,000[g]	600±400	600±300	800±300	600±300	13,100±1,100
Uranium, Total	mg/l	0.02[j]	<0.2±0	<1.0±0	<1.0±0	<1.0±0	N/A

[a] For comparison purposes only.

[b] Mean of multiple samples.

[c] Surface water is monitored at two locations in Pueblo Canyon. The monitoring results presented are from Pueblo 3.

[d] Two locations are normally monitored in Los Alamos Canyon; however, one location was dry at the time of sampling. Results are reported for location DPS-1.

[e] Three locations are monitored in Sandia Canyon. The monitoring results presented are from the sampling location with the highest concentration of the given parameter.

[f] Only one location in Mortandad Canyon is sampled (GS-1).

[g] DOE DCG for drinking water (DOE Order 5400.5). Values are based on a committed effective dose of 100 mrem per year. However, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionuclides are determined by subtracting the instrument background environmental level from the monitored concentrations. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level.

[h] National Secondary Drinking Water Regulations (40 CFR 143).

[i] National Primary Drinking Water Regulations (40 CFR 141).

[j] Proposed National Primary Drinking Water Regulation, Radionuclides (56 FR 33050).

Note: NA=not applicable; N/A=not analyzed.

Source: LANL 1995s.

over a user claiming rights at a later time. All natural water flowing in streams and water courses in New Mexico is considered to be public and subject to appropriation for beneficial use. Beneficial use is the basis, measure, and limit of the right to use water. No water right, therefore, may be granted or claimed for more than the amount that can be beneficially used. DOE owns combined surface and groundwater rights. These rights include the withdrawal of 6,835 million l/yr (1,806 million gal/yr) from a variety of wells and surface diversions under licenses RG–485 through RG–488, 1503, 1802, and 1802–B. DOE also owns a contract for 1,480 million l/yr (391 million gal/yr) of San Juan/Chama Diversion water.

Groundwater. Groundwater in the LANL area exists in three modes—in shallow alluvium in canyons, perched groundwater, and in the main aquifer. The main aquifer consists mostly of clastic sediments within the Santa Fe Group and the Puye Formation. Nearly all groundwater at LANL is obtained from deep wells that produce water from this aquifer. A minor amount of groundwater at LANL is obtained from springs. Most aquifers that lie beneath LANL, with the exception of perched zones, are considered Class II aquifers, having current sources of drinking water and other beneficial uses (DOE 1993j:4-77).

The Santa Fe Group consists of, in ascending order, the Tesuque Formation, Puye Conglomerate, and basaltic rocks of Chino Mesa. The Tesuque Formation contains thin, jointed, interbedded basalt flows that may yield large amounts of water. Some units have lower permeabilities that restrict the movement of water within the formation. The Puye Conglomerate overlies the Tesuque Formation and is highly permeable. When saturated, it yields large amounts of water to wells (LANL 1984a:3).

The depth to the top of the aquifer ranges from about 366 m (1,200 ft) on the west to about 183 m (600 ft) on the east. The total saturated thickness penetrated by production wells ranges up to approximately 518 m (1,700 ft). The most productive area lies in the central portion of the Pajarito Plateau and includes the Pajarito well field. The average drawdown for these wells is 12 m (39.4 ft). The rate of movement of water in the aquifer is approximately 12 to 29 m (39.4 to 95.1 ft) per year (LANL 1984a:7,8).

Groundwater Quality. Most of the wells in the Pajarito Plateau yield fresh water (TDSs less than 500 milligrams [mg]/l or parts per million [ppm]), although some wells east of the site have a higher total dissolved solids content (1,000 mg/l or more). The primary, secondary, and radiochemical groundwater quality, as measured from wells and springs in the main aquifer were below the DOE derived concentration guides or the New Mexico standards applicable to a DOE drinking water system (DOE 1993j:4-77). As shown in Table 3.9.4–2, parameters were below the applicable water quality criteria or standard in the main aquifer in 1993.

Groundwater Availability, Use and Rights. The LANL, the nearby communities of Los Alamos and White Rock, and Bandelier National Monument are entirely dependent on groundwater for their water supply. The water supply is primarily obtained from well fields. During 1993, total production from the wells for potable and nonpotable use was 5,519 million l/yr (1,458 million gal/yr) (LANL 1995r:4). LANL's water system had an average demand equal to about 81 percent of its current allotment of 6,800 million l/yr (1,800 million gal/yr).

Two wells have been drilled recently at LANL, one of which began pumping in the summer of 1992. The newer wells are expected to supplant the now abandoned Los Alamos field. Water is taken from depths of 245 to 550 m (804 to 1,805 ft).

Over the next 50 years, increases in water use may require one of the following: use of the 1,500 million l/yr (396 million gal/yr) San Juan-Chama water (releasing the water in exchange for excess pumping) and/or establishment of credit for return flow (DOE 1993j:4-79).

Table 3.9.4–2. Groundwater Quality Monitoring at Los Alamos National Laboratory, 1993

Parameter	Unit of Measure	Water Quality Criteria and Standards[b]	1993 Existing Conditions[a] Test Well DT-9	Test Well DT-5A	Water Supply Well PM-5	Water Supply Well PM-2
Cesium-137	pCi/L	120[c]	2.1 (1.2)	2.3 (1.4)	0.2 (0.5)	1.4 (1.2)
Chloride	mg/L	250[d,e]	2	2	4	2
Fluoride	mg/L	2.0[e],4.0[f]	0.3	0.3	0.3	0.2
Nitrate	mg/L	10[f]	0.32	0.44	0.10	<0.04
pH	pH units	6.8-8.5[e]	8.2	8.0	7.6	8.2
Plutonium-238	pCi/L	1.6[c]	-0.014(0.030)	-0.014 (0.030)	<0.1 (0)	0.004 (0.030)
Plutonium-239/240	pCi/L	1.2[c]	0.008 (0.030)	0.032 (0.030)	0.03 (0.03)	0.127 (0.024)
Sulfate	mg/L	250[d]	3	3	3	4
Total dissolved solids	mg/L	500[d]	112	104	320	136
Tritium	pCi/L	80,000[c]	300 (300)	400 (300)	400 (300)	500 (300)
Uranium, Total	mg/L	0.02[g]	<2.0 (0)	<2.0 (0)	<1.0 (0)	<1.0 (0)

[a] All data come from groundwater from onsite stations. Samples were collected in 1993.

[b] For comparison purposes only.

[c] DOE DCG for drinking water (DOE Order 5400.5). Values are based on a committed effective dose of 100 mrem per year. However, because the drinking water maximum contaminant level is based on 4 mrem per year, the number listed is 4 percent of the DCG. All concentrations of radionucleotides are determined by subtracting the instrument background environmental levels from the monitored concentrations. A negative or zero incremental concentration means that the concentration at the sampling location is equivalent to the environmental level.

[d] New Mexico State water quality criteria.

[e] National Secondary Drinking Water Regulations (40 CFR 143).

[f] National Primary Drinking Water Regulations (40 CFR 141).

[g] Proposed National Drinking Water Regulations, Radionuclides (56 FR 33050).

Note: Well locations are shown in Figure 3.9.4–1; Parentheses indicate standard error of the mean.

Source: LANL 1995s.

Based on No Action projections, the net growth in overall use is about 0.4 percent per year. Based on this growth rate, the present allotment would be fully used by about 2052. If San Juan-Chama water is added, the limit to the total available supply would be reached by about 2072.

3.9.5 GEOLOGY AND SOILS

Geology. The LANL is located on the Pajarito Plateau, which lies between the Jemez Mountains on the west and the Rio Grande River on the east. The surface of the plateau slopes gently eastward and is dissected by deep, southwest-trending canyons separated by long, narrow mesas. The Pajarito Plateau terminates along its eastern edge along the Puye Escarpment and White Rock Canyon.

The primary controlling feature in the region is the Rio Grande rift that begins in Northern Mexico, trends northwest across central New Mexico, and ends in central Colorado. The rift comprises a series of basins formed by faulting that are filled with sediments derived from highlands to the east and west as well as occasional lake deposits and lava flows. The rift basin in the Los Alamos and Santa Fe area is the Española Basin.

The Pajarito Plateau is capped by the Bandelier Tuff, which consists of a series of ash fall and ash flow tuff (LANL 1984a:6). The major portion of LANL is underlain by the Tshirege member of the Bandelier Tuff, a sequence of cliff-forming welded ash flows with ash fall basal units. The Bandelier Tuff is underlain by sedimentary and volcanic rocks of the Santa Fe Group, which includes the Tesuque Formation, Puye Conglomerate, and basaltic rocks of Chino Mesa (LANL 1984a:3-7).

The LANL lies within Seismic Zone 2 (Figure 3.2.5–1). The strongest earthquake in the last 100 years within an 80-km (50-mi) radius was estimated to have a Richter magnitude of 5.5 to 6 and a MMI of VII. Studies suggest that several faults have produced seismic events with Richter magnitudes of 6.5 to 7.8 in the last 500,000 years (LANL 1987c:ix). LANL operates a seismic hazards program that monitors seismicity through a seismic network and conducts studies in paleoseismology.

The Pajarito Fault system, part of which crosses the western boundary of LANL, is a major, active structural element of the Rio Grande rift. Recent studies have determined that faults within the Pajarito Fault system are capable in accordance with 10 CFR 100, Appendix A (LANL 1987c:ix). Major faults at LANL include the Pajarito, Water Canyon, Rendija Canyon, and Guaje Mountain Faults (Figure 3.9.5–1). The Pajarito Fault is thought to mark the active western boundary of the Española Basin and has evidence of multiple movement in the past 100,000 to 200,000 years. The Rendija Canyon and Guaje Mountain Faults are shorter and secondary to the Pajarito Fault and had movement approximately 8,000 to 9,000 years ago and 4,000 to 6,000 years ago, respectively (DOE 1995hh:4-19).

The 100-year earthquake at Los Alamos is regarded as having a Richter magnitude of 5, with an event of Richter magnitude 7 being the maximum credible earthquake. These values are currently used in design considerations at LANL (LANL 1987c:43,53,54,58).

Geological concerns associated with the LANL area include potential downslope movements in association with regional seismic activity. Although isolated rockfalls commonly occur from the canyon rims, landslides are an unlikely hazard at Los Alamos because of the dry climate, deep water table, and rock characteristics. Although the area has the potential for future volcanic eruptions, the periodicity and structural development of past eruptions indicate a very low probability of an event occurring within the next 1,000 years (LA DOE 1979a:3-17).

Soils. The LANL is underlain by soil types varying in texture from clay and clay loam to gravel. Over 95 percent of the soils are developed on acidic volcanic rocks (LANL 1978a:6,7). Because of the topographic relief of the Pajarito Plateau, rock outcrops occur on greater than 50 percent of the site area.

Water and wind erosion of these soils varies from slight to severe depending on slope, soil grain size, amount of disturbance, and degree of protection. Shrink-swell potential ranges from low to high, correlating with the amount of swelling clays present (LANL 1978a:80). The soils are acceptable for standard construction techniques.

3.9.6 BIOLOGICAL RESOURCES

Terrestrial Resources. The LANL lies within the Colorado Plateau Province. Ecosystems within the laboratory site itself are quite diverse due partly to the 1,500-m (5,000-ft) elevational gradient from the Rio Grande River on the southeastern boundary to the Jemez Mountains, 20 km (12.4 mi) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at LANL has been developed. The remaining land has been classified into seven major vegetative communities as shown in Figure 3.9.6–1.

Within LANL, the predominant community types are juniper grassland in the eastern one-third, pinyon-juniper in the central one-third, and ponderosa pine in the western one-third. The juniper-grassland community is found along the Rio Grande on the eastern border of the Pajarito Plateau and extends upward on the south-facing sides of the canyons at 1,700 to 1,900 m (5,600 to 6,200 ft). The pinyon-juniper community, generally found in the 1,900- to 2,100-m (6,200- to 6,900-ft) elevation range, includes large portions of the mesa tops and north-facing slopes at the lower elevations. The ponderosa pine community is found in the western portion of the plateau and on mesa tops in the 2,100- to 2,300-m (6,900- to 7,500-ft) elevation range. Coniferous trees are the dominant vegetation in the LANL environs, with pinyon pine and one-seed juniper predominate below 2,100 m (6,900 ft), and ponderosa pine and Douglas fir predominate above that elevation (DOE 1995hh:4-39–4-42). Almost 350 vascular plant species have been found, or are likely to be found, on LANL (LA DOE 1979a:3-39).

Terrestrial animal species that can be found on or near LANL include 1 amphibian, 9 reptile, 189 bird, and 45 mammal species (LA DOE 1979a:3-46, C-1–C-3). Undeveloped areas within LANL provide habitat for a diversity of terrestrial wildlife. Species lists have been compiled from observational data and published data, but the occurrence of some species has not been verified (DOE 1995hh:4-42). Among vertebrates, the collared lizard, eastern fence lizard, and whiptail lizard are some of the reptiles found at LANL. Typically, these are found at elevations between 1,910 and 2,134 m (6,265 and 7,000 ft). Bird species that nest in the area include the Mexican spotted owl, great-horned owl, and red-tailed hawk among the raptors, and Say's phoebe, lesser goldfinch, and American robin among other types. Overwintering species include the scrub jay, common raven, and house finch (DOE 1995hh:4-42). Migratory birds and their nests and eggs are protected by the *Migratory Bird Treaty Act*. Eagles are similarly protected by the *Bald and Golden Eagle Protection Act*.

Some of the larger mammals at LANL are the black bear, coyote, and raccoon, while the smaller species include the Mexican woodrat, deer mouse, Abert's squirrel, and mountain cottontail (DOE 1995hh:4-42). The most important and prevalent big game species at LANL are mule deer and elk. LANL lands have traditionally been a transitional area for wintering elk and mule deer. More recently, these two species have been using LANL property on a year-round basis.

Throughout LANL's history, developments within various TAs have caused significant alterations in the terrain and the general landscape of the Pajarito Plateau. These alterations have resulted in significant changes in land use by most groups of wildlife species, particularly birds and larger mammals that have large seasonal and/or daily ranges. Certain projects required the segregation of large areas such as mesa tops, and, in some cases, project areas were secured by virtually impenetrable fences around their perimeters. These alterations have undoubtedly caused some species of wildlife, such as elk and deer, to alter their land-use patterns by cutting off or altering seasonal or daily travel corridors to wintering areas, breeding habitats, foraging habitats, and bedding areas, as well as other necessary habitats.

In 1980, elk were primarily using the southwestern portion of LANL. In addition, critical calving areas and important high-use areas were identified, all of which were primarily in the west and southwest part of LANL. Since 1980, the number of elk using LANL lands increased significantly. Studies of elk conducted from 1991 to 1993 revealed increased use of habitats north and northeast of previously documented high-use areas. There have also been recent concerns about increases in motor vehicle accidents involving elk and deer in the LANL

area. In general, however, little is known of habitat use patterns, population trends, and characteristics of elk on the Pajarito Plateau (DOE 1995hh:4-43).

Wetlands. National Wetland Inventory maps show that most LANL wetlands occur in canyons that drain to the Rio Grande River. Wetlands are found in most of the canyons on the laboratory site including Pueblo, Los Alamos, Sandia, Mortendad, Pajarito, Water, Ancho, Chaquchi, and White Rock (Rio Grande) Canyons. Wetlands have also developed in the vicinity of outfalls from LANL facilities. Most wetlands are classified as riverine intermittent, meaning they may contain flowing water part of the year and may contain pooled water or be dry the remainder of the year. Palustrine emergent and/or scrub-shrub wetlands are also indicated in sections of Pueblo, Los Alamos, Sandia, Pajarito, and Ancho Canyons. Most of the riverine and palustrine wetlands known to exist at LANL are designated as temporary or seasonal by the NWI maps.

Aquatic Resources. Aquatic habitats at LANL are limited to the Rio Grande and several springs and intermittent streams in the canyons. Some of these habitats currently receive NPDES-permitted wastewater discharges. The springs and streams at LANL do not support fish; however, many other aquatic species thrive in these waters (DOE 1995hh:4-43).

The Rio Grande is located along the southeastern property boundary and supports populations of common carp, chub, white sucker, and carpsucker. Game fish inhabiting the Rio Grande River in the vicinity of LANL include the channel catfish and brown trout (LANL 1992a:3).

Threatened and Endangered Species. Twenty federally or State-listed threatened, endangered, and other special status species may be found on and in the vicinity of LANL (Table 3.9.6–1). Four of these species have been observed on LANL. The federally listed species recorded onsite include the Mexican spotted owl, which has recently been observed nesting near TA-15 (two young were fledged from this nest during the 1995 breeding season) (DOE 1995hh:4-45), the bald eagle, which winters along the Rio Grande River, and peregrine falcon, which historically nested onsite and occasionally still forages there. The State-threatened Jemez Mountain salamander has also been observed onsite. LANL canyons provide suitable nesting, roosting, and foraging habitats for the Mexican spotted owl. No critical habitat for threatened or endangered species, as defined in ESA (50 CFR 17.11; 50 CFR 17.12), exists on LANL; however, critical habitat for the Mexican spotted owl has been designated in areas bordering the northern and western boundaries of LANL (60 FR 29914).

Table 3.9.6–1. Federally and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found on or in the Vicinity of Los Alamos National Laboratory

Common Name	Scientific Name	Status[a]	
		Federal	State
Mammals			
New Mexican meadow jumping mouse	*Zapus hudsonius luteus*	NL	T
Spotted bat	*Euderma maculatum*	NL	T
Birds			
Baird's sparrow	*Ammodramus bairdii*	NL	T
Bald eagle[b,c]	*Haliaeetus leucocephalus*	T	T
Broad-billed hummingbird	*Cynanthus latirostris*	NL	T
Common black-hawk	*Beuteogallus anthracinus*	NL	T
Gray vireo	*Vireo vicinior*	NL	T
Mexican spotted owl[c]	*Strix occidentalis lucida*	T	NL
Peregrine falcon[b,c]	*Falcon peregrinus*	E (S/A)	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	T
Whooping crane[b]	*Grus americana*	E	E
Amphibians			
Jemez Mountain salamander[c]	*Plethodon neomexicanus*	NL	T
Fish			
Rio Grande silvery minnow	*Hybognathus amarus*	E	T
Invertebrates			
Say's pond snail	*Lymnaea caperata*	NL	E
Plants			
Checker lily	*Fritillaria atropurpurea*	NL	R
Giant helleborine orchid	*Epipactis gigantea*	NL	RS
Golden lady's slipper	*Cypripedium pubescens*	NL	E
Sandia alumroot	*Heuchera pulchella*	NL	RS
Santa Fe cholla	*Opuntia viridiflora*	NL	E
Wood lily	*Lilium philadelphicum var. andinum*	NL	E

[a] Status codes: E=endangered; NL=not listed; R=State rare plant review list; RS=State rare and sensitive plant species; S/A=protected under the similarity of appearances provision of the *Endangered Species Act*; T=threatened.

[b] USFWS Recovery Plan exists for this species.

[c] Species recorded on LANL.

Source: 50 CFR 17.11; 50 CFR17.12; DOE 1995hh; LANL 1996e:2; NM DGF 1990b; NM DGF 1995a; NM FRCD 1995a.

3.9.7 CULTURAL AND PALEONTOLOGICAL RESOURCES

Prehistoric Resources. Prehistoric site types identified in the vicinity of LANL include large multiroom pueblos, field houses, talus houses, shrines, rock shelters, animal traps, hunting blinds, water control features, agricultural fields and terraces, quarries, rock art, trails, campsites, windbreaks, rock rings, and limited activity sites. Approximately 75 percent of LANL has been inventoried for cultural resources. Coverage for many inventories has been less than 100 percent; however, approximately 60 percent of LANL has received 100-percent coverage. More than 1,300 prehistoric sites have been recorded at LANL, and approximately 95 percent of these sites are considered eligible or potentially eligible for the NRHP. Two areas in the vicinity of LANL have been established as NRHP sites or districts: Bandelier National Monument (named as a monument in 1916) and Puye Cliffs Historical Ruins.

Historic Resources. Historic resources consist of homesteads, corrals, ditches, trash scatters, roads and trails, railroads, ranches, mines, remains of commercial ventures, and buildings associated with the Manhattan Project and the Cold War era. More than 80 historic resources have been recorded at LANL, and about 90 percent of the resources are considered eligible or potentially eligible for the NRHP.

The existing LANL facilities have been extensively modified and refurbished since 1943 when major construction occurred after World War II. The existing facilities are not likely to be considered NRHP eligible because they lack architectural integrity and may not be representative of a particular style. However, some of the facilities may be NRHP eligible based on their association with the broad historic theme of the Manhattan Project and initial nuclear production.

Portions of a number of TAs have been surveyed. NRHP-status buildings exist in TAs -3, -8, -9, -16 (74 individual buildings); TA-22 (TA-22-1); TA-28; and TA-55. Structures at the front and back gates are also eligible for the NRHP. Additional NRHP-eligible historic resources may exist in other TAs.

Native American Resources. Native Americans in the area with concerns include the six Tewa-speaking Pueblos of the northern Rio Grande Valley (San Ildefonso, San Juan, Santa Clara, Nambe, Tesuque, and Pojoaque), and the Cochiti and Jemez Pueblos.

Cultural resources are of special importance to Native Americans. These resources located on the LANL site may consist of prehistoric sites with ceremonial features such as kivas, village shrines, petroglyphs, or burials, or traditional cultural properties with no observable manmade features. Consultations by DOE with local Native Americans to identify any such cultural resources have been conducted in the past and are ongoing. An ethnographic study is currently being conducted to identify traditional cultural properties in the area as part of a sitewide EIS for LANL.

Paleontological Resources. The Pajarito Plateau consists primarily of Pleistocene volcanic tuffs and compacted pumice and ashfalls of the Bandelier Formation. None of the formations within LANL are known to be fossiliferous.

3.9.8 SOCIOECONOMICS

Socioeconomic characteristics addressed at LANL include employment and regional economy, population and housing, community services, and local transportation. Statistics for employment and regional economy are presented for the REA that encompasses seven counties around LANL located in New Mexico (Table L.1–1). Statistics for population and housing, community services, and local transportation are presented for the ROI, a three-county area in which 88.1 percent of all LANL employees reside: Los Alamos County (48.3 percent), Rio Arriba County (20.8 percent), and Santa Fe County (19.0 percent) (Table L.1–9). More than half of the Los Alamos County employees reside in the unincorporated communities of Los Alamos and White Rock. In 1995, LANL employed 8,655 persons.

Regional Economy Characteristics. Selected employment and regional economy statistics for the LANL REA are summarized in Figure 3.9.8–1. Between 1980 and 1990, the civilian labor force in the REA increased 34.1 percent to the 1990 level of 100,300. The 1994 unemployment rate in the REA was 6.2 percent, which was about the same as the unemployment in New Mexico (6.3 percent). The region's per capita income of $17,689 in 1993 was approximately 8.2 percent higher than New Mexico's per capita income of $16,346.

As shown in Figure 3.9.8–1, the REA and New Mexico have similar employment patterns. The service sector accounts for the largest share of employment in both the region (31.2 percent) and in New Mexico (28.3 percent). Retail trade employment was approximately the same for the region (18.2 percent) and New Mexico (18.1 percent). Manufacturing employment accounted for 4.0 percent of the total regional employment but 5.8 percent of the total State employment.

Population and Housing. In 1994, the ROI population totaled 166,788. From 1980 to 1994, the ROI population grew by 36.6 percent, compared to 26.9 percent for New Mexico. Within the ROI, Santa Fe County experienced the largest increase at 48.6 percent. Population and housing trends are summarized in Figure 3.9.8–2. The unincorporated communities of Los Alamos and White Rock in Los Alamos County are included in the county population and housing analysis.

The 37.8-percent increase in the number of housing units between 1980 and 1990 for the ROI was much greater than the percent increase for New Mexico (24.5 percent). The total number of housing units for 1990 was 63,386. The 1990 homeowner vacancy rate in the ROI, 2.3 percent, was the same as New Mexico's homeowner vacancy rate. The rental vacancy rate for the ROI counties, 7.7 percent, was much less than New Mexico's rental vacancy rate (11.4 percent).

Community Services. Education, public safety, and health care characteristics were used to assess the level of community service in the LANL ROI. Figure 3.9.8–3 presents school district characteristics for the LANL ROI. Figure 3.9.8–4 presents public safety and health care characteristics.

Education. In 1994, seven school districts provided public education services and facilities in the LANL ROI. As shown in Figure 3.9.8–3, these school districts operated at between 57.4 percent (Chama Valley Independent School District) and 75.7 percent (Espanola Public School District) capacity. The average student-to-teacher ratio for the LANL ROI in 1994 was 17.3:1. The Espanola Public School District had the highest ratio at 18.9:1.

Public Safety. City, county, and State law enforcement agencies provided police protection to the residents in the ROI. In 1994, a total of 263 sworn police officers were serving the three-county ROI. The City of Santa Fe employed the greatest number of sworn police officers (104), while the City of Espanola had the highest officer-to-population ratios (2.5 sworn officers per 1,000 persons). The ROI average officer-to-population ratio was 1.6 officers per 1,000 persons. Figure 3.9.8–4 compares police force strengths across the ROI.

Fire protection services in the LANL ROI were provided by 800 paid and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was located in Rio Arriba County, 10.2 firefighters per

1,000 persons, as indicated in Figure 3.9.8–4. Rio Arriba County employed the greatest number of firefighters (276). The average firefighter-to-population ratio in the ROI was 4.7 firefighters per 1,000 persons.

Health Care. There were four hospitals serving the three-county ROI in 1994. Figure 3.9.8–4 displays the hospital bed-to-population ratios for the LANL ROI counties. During 1994, all hospitals were operating at below capacity, with hospital occupancy rates ranging from 28.3 percent in Los Alamos County to 31.1 percent in Rio Arriba County.

In 1994, a total of 311 physicians served the ROI, with the majority (244) located in Santa Fe County. Figure 3.9.8–4 shows that the physician-to-population ratio for the ROI ranged from 0.6 per 1,000 persons in Rio Arriba County to 2.4 per 1,000 persons in Los Alamos County. The ROI average physician-to-population ratio was 1.9 physicians per 1,000 persons.

Local Transportation. Regional transportation routes provide access to LANL (see Figure 2.2.8–1 and Figure 2.2.8–2 for maps of regional and local roads near LANL). Interstate 25 provides access to Denver, CO, to the north and Albuquerque, NM, to the south. Interstate 40 and Interstate 25 intersect at Albuquerque, NM. Interstate 40 provides access to Amarillo, TX, to the east and Flagstaff, AZ, to the west. U.S. 285 meets Interstate 25 at Santa Fe. U.S. 285 is to the east of LANL.

Vehicular access to LANL is provided by New Mexico Route 502 to the east and New Mexico Route 4 to the west. New Mexico Route 502 intersects U.S. 285 at Pojoaque, New Mexico. New Mexico Route 4 intersects New Mexico Route 44 at San Ysidro.

There are no current or planned (within 1 to 2 years) road improvement projects that would affect access to LANL (NM DOT 1995a:1). There is no public bus service at LANL. There is a non-profit bus service between White Rock, LANL, and Los Alamos (LA DOE 1995a:1.)

The only major railroad in the ROI is the Burlington Northern and Santa Fe. A spur of this railroad extends to Santa Fe, NM, from the south. There are no navigable waterways within the ROI that are capable of accommodating waterborne transportation of material shipments to LANL. The Albuquerque International Airport provides passenger and cargo service in the ROI on national and international carriers (DOT 1992a:7-214–7-217). There are other smaller airports in the ROI.